DOCUMENT RESUME

ED 260 911 SE 045 949

AUTHOR Brody, Michael J.
TITLE The Floating Lab Research Project: An Approach to Evaluating Field Programs.
INSTITUTION Cornell Univ., Ithaca, NY. Dept. of Environmental Education.
SPONS AGENCY Maine Univ., Orono. Sea Grant Program.; New Hampshire Univ., Durham.
PUB DATE [84]
NOTE 14p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Concept Formation; Concept Teaching; Environmental Education; *Experiential Learning; Field Instruction; Grade 8; Junior High Schools; *Marine Education; *Oceanography; *Outdoor Activities; Program Evaluation; Science Education; Seafarers; *Secondary School Science
IDENTIFIERS *Concept Maps; Science Education Research

ABSTRACT

This report explains an evaluative study of the conceptual and affective development of students associated with the Floating Lab Program, an experiential field project sponsored by the University of New Hampshire and the Maine Sea Grant Program. The field program involved an opportunity for students to have hands-on experiences aboard a 65-foot vessel outfitted with various kinds of oceanographic sampling equipment. Students and teachers operate equipment, collect samples, and record data. An assessment of this experience was made with 20 eighth grade students. Modified clinical interviews that incorporated concept mapping and concept propositional analysis were administered pre- and post-trip. Results indicated that students interviewed exhibited an increase in marine science concepts and values toward coastal zone resources. The report includes a number of knowledge and value claims and recommendations for teachers, program developers and researchers. (ML)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED260911

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

THE FLOATING LAB RESEARCH PROJECT:

AN APPROACH TO EVALUATING FIELD PROGRAMS

I CANNOT THINK WHEN I LOOK AT THE OCEAN
THE OCEAN ITSELF IS TOO MUCH TO THINK ABOUT
ITS TWIRLING SURF CAPTURES MY MIND
GRASPING MY BODY LIKE A GIANT HAND .....

I TURN FOR ONE LAST LOOK
THE OCEAN BIDS ME GOODBYE
SPARKLING LIKE A JEWEL
THAT WILL ALWAYS BE TREASURED

(STUDENT)

MICHAEL J. BRODY
DEPARTMENT OF EDUCATION
STONE HALL
CORNELL UNIVERSITY
ITHACA, NEW YORK 14853

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Michael Brody
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

SE 045 949

Abstract

This research project is supported by the University of New Hampshire and Maine Sea Grant College Program and the Department of Environmental Education, Cornell University. The purpose of the study is to investigate and evaluate development of students in the Floating Lab Program.

The project is based on the Sea Grant philosophy of public education to promote wise use, conservation and development of marine resources through research, education and advisory service activities. The project incorporates a theory of meaningful learning and conceptual approach to program development.

The field program involves use of a research vessel which allows students to investigate the marine environment using oceanographic research methods. Teachers receive the Floating Lab Resource Manual containing background information and pre and post lab activities. Prior to the field trip teachers attend two workshops; the first in the laboratory at the University of New Hampshire and the second aboard the vessel in Hampton-Seabrook Harbor.

Our research concerns the conceptual and affective development of the students. We have completed pre and post trip interviews. These modified clinical interviews incorporate concept mapping and concept-propositional analysis.

Results indicate that students interviewed exhibited an increase in marine science concepts and values toward coastal zone resources. The report includes a number of knowledge and value claims and recommendations for teachers, program developers and researchers.

I. Philosophy and Program

New Hampshire's coast - its marshes, estuaries, beaches, rocky shoreline and open ocean - has been a vital resource since colonial times. It continues to provide food, transportation, jobs, recreation and an attractive place to live. Population growth, increasing utilization of resources and probable impacts of energy development place the future of the coast in jeopardy. Vital decisions will be made in the next few decades by the students who are in our schools today. By increasing their knowledge and appreciation of our coastal resources, we can ensure that those decisions will be enlightened ones and that the future of the New Hampshire coast will be bright.

Since 1977 the University of New Hampshire and Maine Sea Grant Program has sponsored the Floating Lab: an opportunity for students to have "hands on" experiences aboard a 65-foot vessel outfitted with various kinds of oceanographic sampling equipment. The project is based on the Sea Grant philosophy of public education to promote wise use, conservation and development of marine resources through research, education and advisory service activities. The Floating Lab Program enables students to observe physical ocean processes such as waves and currents. They collect samples, record data and analyze it in a meaningful way. Through the field experience students examine various ecosystems found in the Hampton-Seabrook areas and observe man's use of these resources.

Teachers receive the Floating Lab Resource Manual containing background information and pre and post lab activities. Two workshops are required in the program to help teachers and other adult chaperones fully participate in the Lab experience. The first workshop introduces curriculum and equipment, discusses logistics of the trip and acquaints teachers and chaperones with selected pre and post-cruise activities. The second is aboard the Lab itself, for familiarization with the onboard activities and oceanographic methods. All participants are asked to look critically at their Floating Lab experience, so the program, including the manual as well as the field work, can be revised and improved as a result of their constructive suggestions and evaluations.

The Floating Lab research vessel outfitted with sampling equipment is located at the Eastman's dock in Hampton Harbor. The Lab stops at three sampling locations beginning at the dock and proceeding out towards Jeffrey's Ledge. Students and teachers participate fully, operating equipment, collecting samples and recording data. The trip takes four hours. Back in their classrooms, students analyze their data and report their results to the Marine Advisory Program. Data from all participating schools is compiled and returned to the students and their teachers for further analysis.

II. Meaningful Field Programs

Field experiences can often by a mixed bag of emotions and outcomes for teachers and students. Students may come away with a great feeling for having been out of school but with little new knowledge. Teachers may question the worth of such activities when little seems to be accomplished.

In order to be more effective, Field Marine Science can easily employ a theory of meaningful learning based on the interaction of thinking, feeling and acting.

The "thinking" component involves the assimilation of new knowledge on the part of the learner. It is necessary to realize that the material that will be taught is made up of concepts which can be linked in a non arbitrary way with other relevant concepts. Concepts are regularities in events or objects designated by some sign in symbol. A proposition is two or more concepts linked in a non arbitrary way. The concepts of ocean and movement can be linked in the proposition "the ocean exhibits movement" and can be further linked with concepts such as tides, waves and currents. The knowledge we wish to teach should be organized into concepts and propositions which we consider critical to the field experience. It is also important to realize that each students presents us with an organized framework of knowledge. The integrating of new knowledge in a non-arbitrary way to the students' relevant concepts results in meaningful learning.

Through field work students can participate in "acting" by learning skills and using them to investigate the important aspects of the environment. Traditional oceanographic methods investigating salinity, temperature or distribution can greatly enhance meaningful learning. Educating takes place in time and space. Field programs provide the time and environment to easily integrate acting into educating. It is hoped through this integration of thinking, feeling and acting that students will grasp the meaning of the material, feel its significance and change the meaning of future experiences in terms of the environment and themselves.

Finally, meaningful learning leads to understanding for appreciation. Our values are shaped by our knowledge. Grasping the meaning of knowledge and feeling its significance brings cognitive and affective components together. Field programs should empower students to connect things, to separate things and to see why such combinations are together. What are the cross linkages between population, energy, environmental quality and quality of life? Educating can be significant when we increase a student's meaningful connections in experience.

III. Methods

This research project asks the question, "Do students in the Floating Lab Program learn marine science concepts and develop an understanding and appreciation of coastal resources?" Twenty students (with their parents' permission) volunteered to participate. All were eighth grade students attending Exeter Junior High School in Exeter, New Hampshire. The boys and girls were divided evenly between classes taught independently by two different teachers. Each student was interviewed in April before the Floating Lab Program and again interviewed in June following instruction.

The first step was to isolate areas of the program that could be used as a focus for the interviews.

Three areas of the curriculum were selected which represent physical, biological and social aspects of instruction. These were the concepts of sea water, classification of marine organisms and coastal zone resources.

Each of these concepts was then investigated in terms of background information in the resource manual, related pre and post lab activities and on board instruction. Based on this information concept maps of each topic were constructed. These maps represented the structure of the knowledge found in the program.

B. What is Concept Mapping?

Concept Maps are two dimensional representations between concepts expressed simply as an hierarchical arrangement of concept labels and linking words. The concepts of animal, invertebrate and backbone can easily be mapped as indicated.

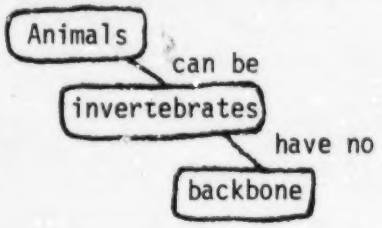


Figure 1.

This mapping generates the propositions: Animals can be invertebrates and invertebrates have no backbones. Further meanings of the concept "invertebrates" can be determined by other propositions which contain that concept. "Invertebrates include jellyfish"; "Invertebrates may be planktonic"; "Invertebrates exhibit reproduction"; etc. are propositions that give meaning to the concept invertebrates when the propositions are learned. Concept maps represent simple propositional structures that illustrate principal meanings of the component concepts.

In this case, mapping was used as a tool to analyze and represent the conceptual and propositional structure of a body of subject matter. The following diagram is a map of seawater and related concepts found in the Floating Lab Manual (see Figure 2).

The seawater concept map does not include all of the possible concepts that could be associated with it. An "expert" would be able to include others and expand the map considerably. Those concepts included are those emphasized on board the vessel.

Concept mapping is a technique for externalizing concepts and propositions. Often maps help us to recognize new relationships and meaning in old and familiar material.

Maps were also constructed for the "classification of marine organisms" and "coastal zone resources". (see Figures 3a and 3b)

C. The Interview

It was largely the work of Jean Piaget and his colleagues in Switzerland that perfected the use of the clinical interview as an assessment tool. However recent research has since modified those techniques to include more flexible tasks and questions which probe the student's cognitive structure.

The concepts of sea water, classification and coastal zone resources were selected as the content of the interviews. The concept maps were used to prepare the interview and guided in selecting interview questions and auxiliary materials (see Table 1).

BEST COPY AVAILABLE

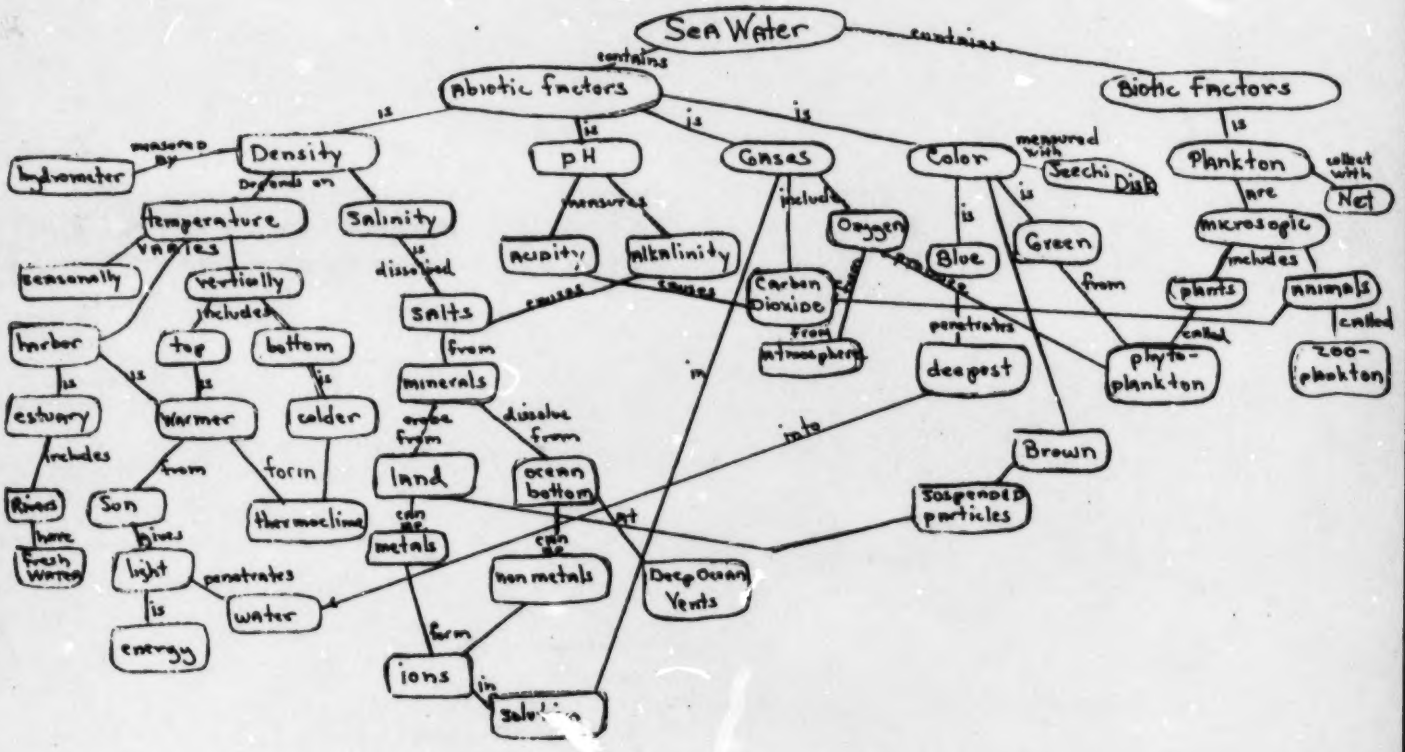


Figure 2. Sea Water Concept Map

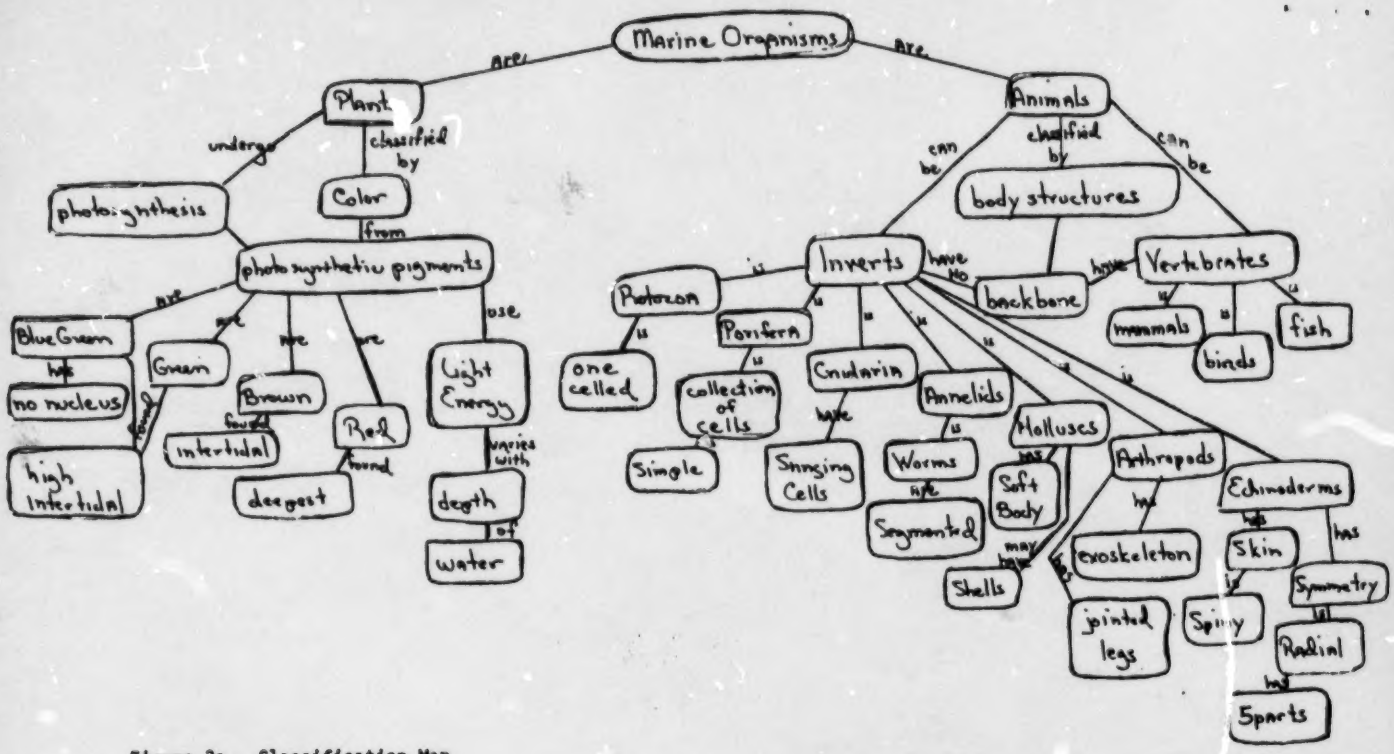


Figure 3a. Classification Map

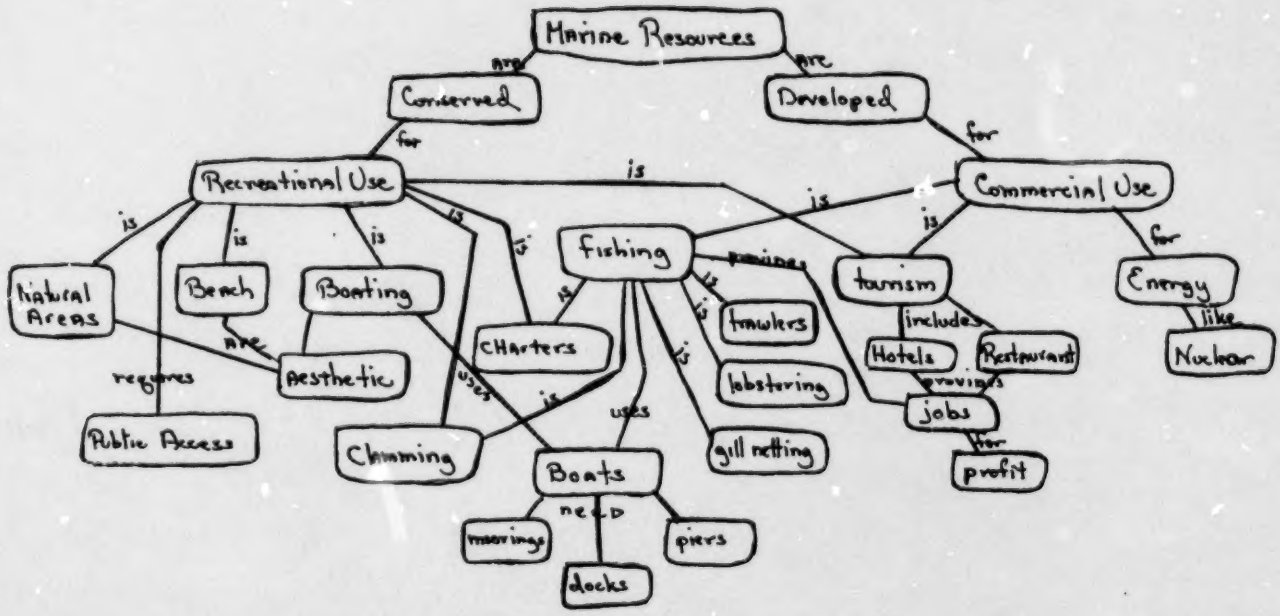


Figure 3b. Marine Resource Map

BEST COPY AVAILABLE

Table 1. Auxiliary Materials

Concept	Interview (Props)
Sea water	1. hydrometer/thermometer 2. fresh water 3. sea water 4. graduated cylinder
Classification	1. pressed green, brown, red algae 2. assortment of shells, tests and exoskeletons 3. pictures of different types of fish and plankton
Coastal Zone Resources	1. Two maps of Hampton-Seabrook area: a. natural features only b. included roads and other development 2. Several pictures of different fishing vessels

These auxiliary materials or props served as the starting points for questions. Open-ended questions such as "How would you explain why the hydrometer sinks in this liquid?" of "What is different about these seaweeds?" elicited comments from which other questions (suggested by concept maps) easily followed. Questioning proceeded from more familiar areas of subject matter to less familiar and from broad, inclusive questions to more detailed, specific questions. Because interviews will underestimate knowledge it is necessary to probe into the student's cognitive structure as much as possible. An example of probing can be found around the concept of classification of algae by color. Most students realized algae could be divided into red, green and brown but could not explain why the different colors existed. Some of these students when probed about photosynthetic pigments understood the role of chlorophyll in land plants and why leaves changed colors in the fall. These students could then link the concepts of photosynthetic pigments, fall colors and coloration of algae. However none could explain why different pigments are needed in the marine environment.

Interviews were held during the normal class day, one interview per class period. The interviews lasted approximately one half hour each. They were conducted in the mathematics office which was private and quiet. Each interview was taped on a cassette recorder and three were videotaped for later consideration of improved interview style.

It is necessary to point out here that interviewers must be thoroughly familiar with the subject matter field. Some interviewee responses may need to be viewed from a broad perspective to be seen as interesting or creative. Only an interviewer who has a thorough knowledge of the field can respond with appropriate follow-up questions or probes in such cases. Concept mapping of topics helps to familiarize and broaded perspective of the topics.

D. Evaluating the interviews

When clinical interviews are designed from a concept map, a "template" map exists which can be used to construct and evaluate students' cognitive maps. The procedure is to construct a map from the interview tape that shows concepts and propositions evidenced in the interview by each student. However it must be kept in mind that we are all prisoners of our own cognitive structure and we must search for stable patterns and frameworks through which individuals and experts report on objects and events they observe.

Figures 4 and 5 are concept maps constructed from one student's pre and post interviews. At first glance it is easy to recognize that this students has a more elaborate post map with many more circles and lines. This indicates more concepts and relationships between them. This is a preliminary qualitative assessment.

Criteria for evaluating the concept maps constructed from the interviews are as follows:

1. concepts
2. propositions
3. cross links
4. misconceptions

Looking at Figs. 4 and 5 it can be determined that:

1. The number of concepts increased. New ones included estuary and birds.
2. Number of valid propositions increased. Notice relation of estuary, river and salinity or light, blue green, depth and red algae.
3. There are more meaningful connections between the segments of concept map on the post map. Note oxygen from plants or red alge found deepest.
4. Note the number of relationships for density. The increase shows the gradual differentiation of the conceptual framework of the student.
5. Some misconceptions remain after instruction. For example the concept of animal classification pre and post remains based on bahavior and habitat.

Another approach utilized in this study for evaluating interviews is called concept propositional analysis (CPA). Used before and after instruction this allows the construction of:

1. propositions given by students to questions before instruction
2. key propositions presented in instruction
3. propositions given by students to same questions after instruction

This technique is very useful for teachers. The starting point in instruction should be the set of propositions held by the student. Teaching to the students' relevant concepts can improve curriculum development and instruction.

BEST COPY AVAILABLE

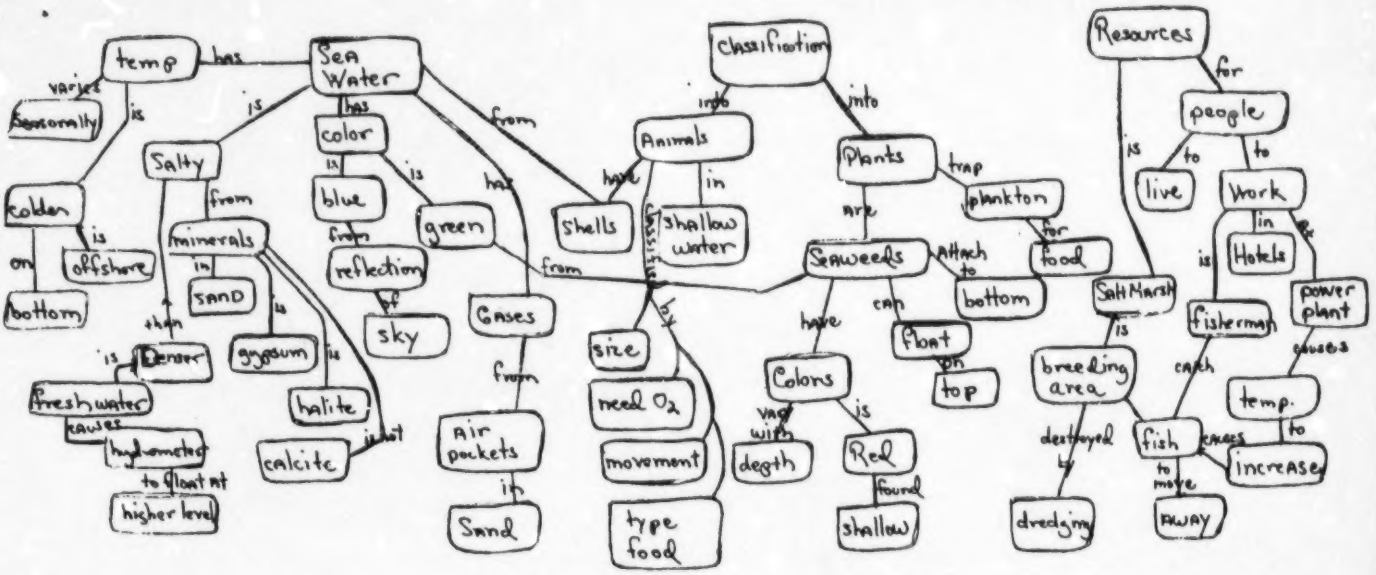


Figure 4. Pre Interview Map

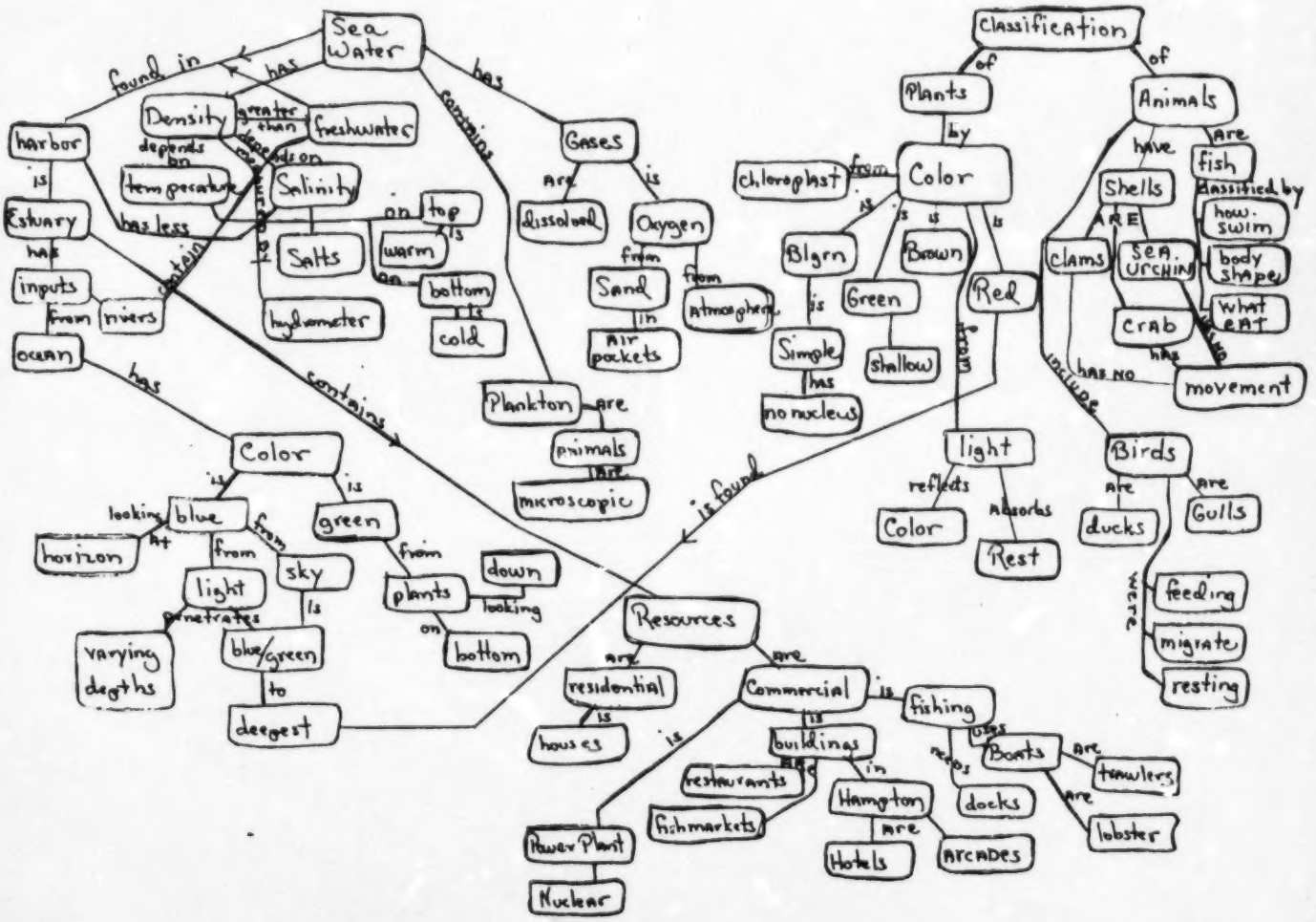


Figure 5. Post Interview Map

A good example of CPA from the above maps includes the concepts of ocean and blue.

1) In the pre interview the student stated that "the ocean is blue because of the reflection of the sky".

2) The key concepts presented in instruction are that "when looking at the horizon the ocean appears blue because light from the sun is selectively absorbed. Blue wavelengths penetrate the deepest and thus reflect back the color blue."

3) In the post interview the student asserts, "the ocean, when looking at the horizon, is blue because of the sky". Later in the interview, however, he states, "light penetrates the ocean to varying depths and blue green wavelengths penetrate the deepest".

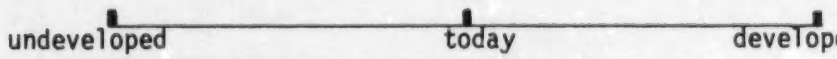
Analysis of such data can lead teachers to key concepts that the student possesses which need to be clarified, introduced or reinforced. This student needs to have light penetration concepts reinforced and linked up more correctly with the concept of ocean color. Although he possesses new knowledge from his experience the concept of color and light penetration need to be integrated.

E. Values, attitudes and appreciation

During the course of the investigation it became apparent that the modified clinical interview provided an opportunity to discuss students' feelings about their experience and the environmental setting of the program.

In the pre interview, questions proceeded from the concept of marine resources, various interest groups, development and future use. Students were asked what might happen if development continued and how might it effect future use of that area.

In the post interviews, students were asked to describe what they thought the Hampton Seabrook estuary was like; one hundred years ago, today and in the future. Students were given a choice of how they would like to see the estuary in the future and asked to place themselves on a continuum from developed to undeveloped with today in the middle.



Finally, they were asked what they considered the best and worst things about the environment when they were there and why they thought so.

IV. Results

Based on the "criteria of excellence" as proposed by educators and particularly marine educators the Floating Lab Program can be classified as a truly educative event. The interviews with students have allowed the identification of concepts presented by participants. The tapes allow these to be replayed with reliability. In order to understand the program better, key concepts in these tapes have been identified and constitute facts around which can be made factual judgements about student cognitive and affective development.

These factual judgments can be divided into two groups:

Knowledge Claims are the product of inquiry of the researcher. They are the result of deliberate making and doing and are directly related to the pattern of inquiry that produced them.

Value Claims assert the worth of something. Knowledge claims are surrounded by value claims. They can be divided into economic, aesthetic, social or moral standards.

The majority of the students interviewed can be characterized by the claims below. Most knowledge claims are followed by an example of the type of comment which elicited such a claim.

1. Knowledge Claims

a. The concept of density, temperature and salinity relationships was understood by students after instruction. It was not understood before.

(post) "when salinity increases so does density"

(post) "colder water is found on the bottom because it is more dense"

b. The proposition, "seawater is basic", was learned

(post) "ocean water has a pH of about 8 which is alkaline". However because students could not explain why or relate pH to other concepts,it appears the student's experience enabled them to rote memorize the pH of seawater.

c. Although most students learned that light selectively penetrates water, they did not associate it with the blue appearance of the ocean. This concept needs to be clarified and then integrated into the student's cognitive structure.

d. Students' pre interviews indicate they knew ocean water contained gases but the program reinforced and expanded the concept of oxygen dissolved in sea water.

(post) "there's much more oxygen dissolved than is necessary for life found there"

e. The concept of algal classification was missing pre-instruction. After the program students understood the grouping by color but did not associate colors with photosynthetic pigments.

f. Students continued to classify animals by size, feeding behavior, movement and habitat. Classification based on structure could be easily integrated into the field program by sorting collected animals into groups on board the vessel.

g. After the field program students knew more uses of marine resources in terms of their availability in Hampton-Seabrook Harbor.

(post) "includes fishing and other commercial uses, residential areas and recreational activities."

h. Students considered the "best" aspect of environment to be aesthetic values.

(post) "peaceful, openness, view"

i. The nuclear power plant was considered "worst: part of environment.

(post) "pollution and interaction of temperature and organisms"

j. Students given a choice for the future placed themselves on a development continuum at present levels or slightly towards undeveloped.

(post) "retain untouched areas" .

k. The integration of new knowledge in a non-arbitrary way to the student's relevant concepts resulted in meaningful learning.

2. Value Claims

a. Clinical interview, concept mapping and concept propositional analysis provide an effective strategy for evaluating marine field programs.

b. The methodology described is an effective way for teachers to design future educational programs. The design of curriculum can be powerful when the student's existing cognitive structure is taken into consideration.

c. As an evaluation tool the methodology described requires a significant investment of time. Efficiency can be achieved in longer programs by having students construct their own concept maps.

d. The research strategy described can be converted to a more quantitative study using a standardized method of scoring concept maps.

e. Through the Floating Lab Program students learned the concepts of conservation and development of marine resources and understood the need for a balance of natural areas and man's activities.

f. This research project proved to be a satisfying experience for the participants. It is based on a humanistic approach with close interaction of students, teachers and research.

3. Recommendations

a. Research should continue in the form of a long term study. Participants in junior high school could be interviewed as seniors (voting adults) four years later to determine if their Floating Lab Experience sets them apart from a normal population of students.

b. Techniques should be used in other marine education programs especially those which extend over longer periods of time. This would allow for refinement of methodological techniques and provide the opportunity for more quantitative assessment of results.

c. The Floating Lab Program should work towards:

1. clarifying algal classification and photosynthetic pigments
2. classification of animals based on structures
3. introducing sea and shore bird ecology

d. Educators should integrate major concepts of this report to affect more meaningful learning through field programs.